



## **Review and Comparison of Radar Rainfall Bias Adjustment Methods**

*applying a 10-year dataset from Denmark*

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# Review and comparison of radar rainfall bias adjustment methods

– Applying a 10-year dataset from Denmark

## 1. Concept

- To develop a complete 10-year dataset of the best possible adjusted radar rainfall data in the best possible spatial and temporal resolution.

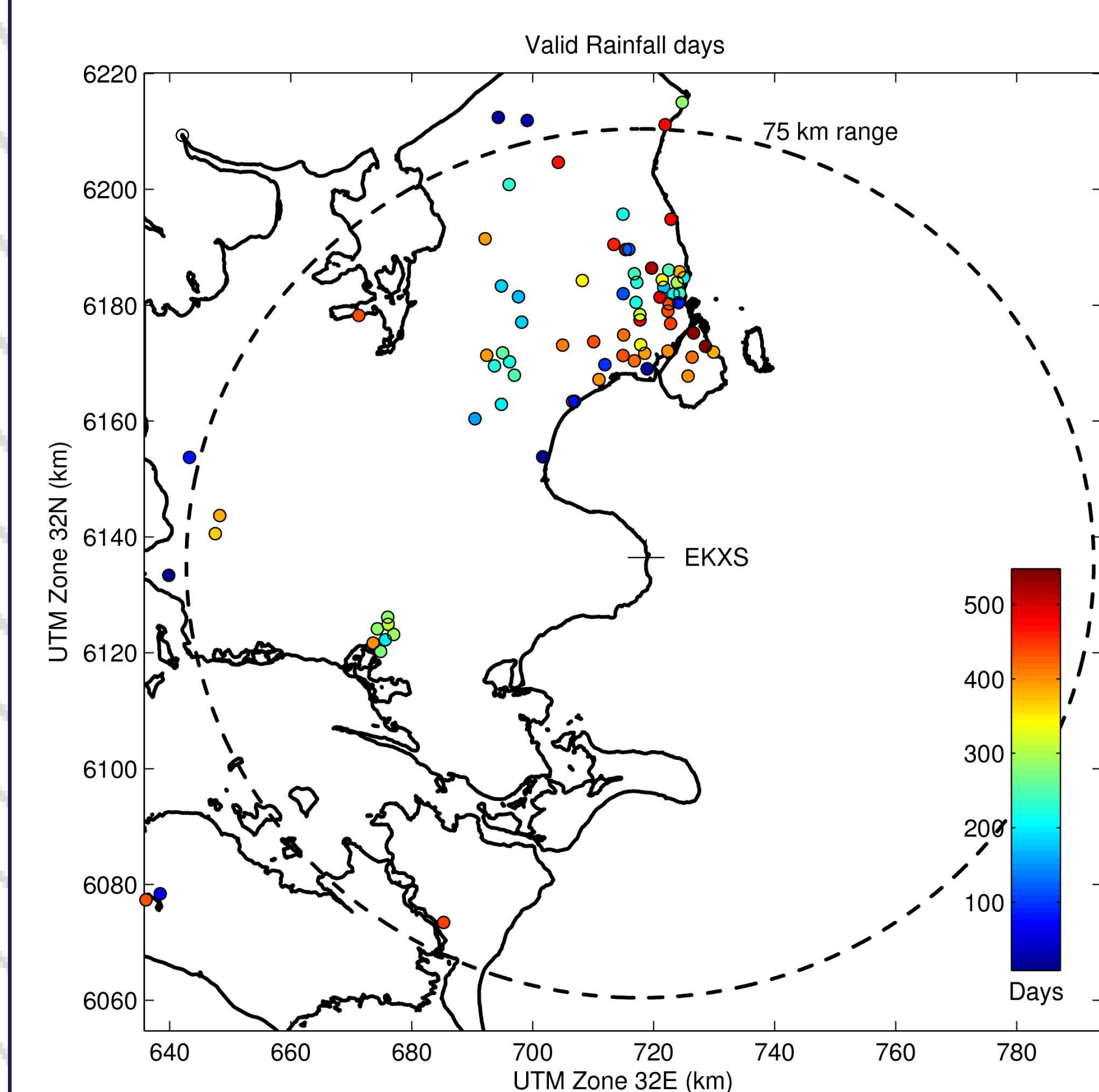
## 2. Objectives and Methods

Based on the 10 year dataset we investigate and evaluate the following:

- Mean Field Bias (MFB) adjustment** with special focus on the temporal integration.  
We assume a constant multiplicative bias between rain gauge observations and radar rainfall estimates (with fixed Z-R relationship) at different time scales.
- Conditional Mean Field Bias adjustment (CMFB)**  
We allow bias to change as a function of the rain rate in order to improve adjustment during heavy rain (convective events).
- Implementation of **Advection Interpolation** to increase the temporal resolution of radar rainfall estimates.  
We apply weighted forward and backward advection interpolation based on the COTREC scheme (Continuity Tracking Radar Echoes by Correlation).

## 3. Data

- 10 years of radar observations (2002-2012) from DMI C-band radar at Stevns (EKXS).
- DMI CAPPI product (resolution: 500 x 500 m<sup>2</sup>, 10 min.)
- Reflectivity - rain rate conversion following Marshall-Palmer, A=200, B=1.6
- 49-79 rain gauges within the 75 km range (resolution: 0.2 mm, 1 min.)
- Gauge density within the 75 km range: 1 gauge per 260 km<sup>2</sup>



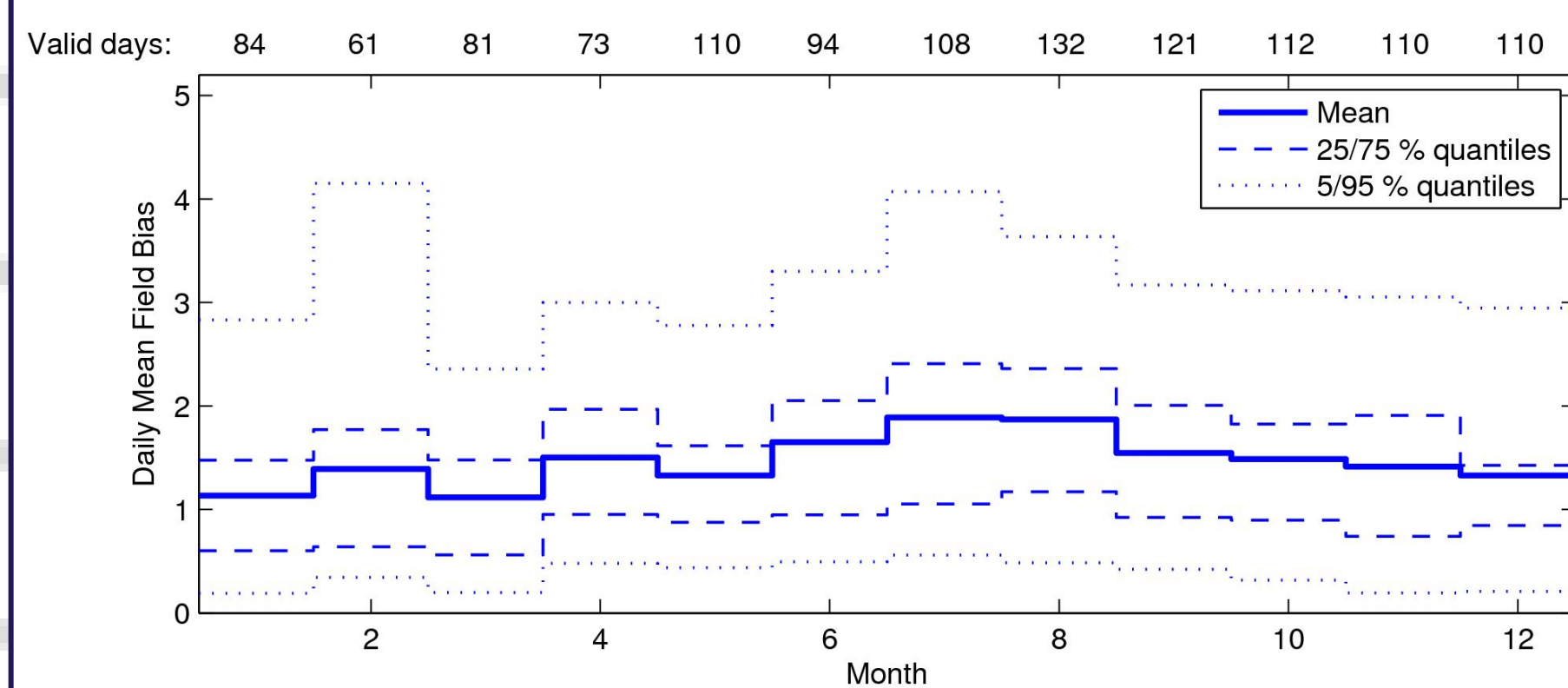
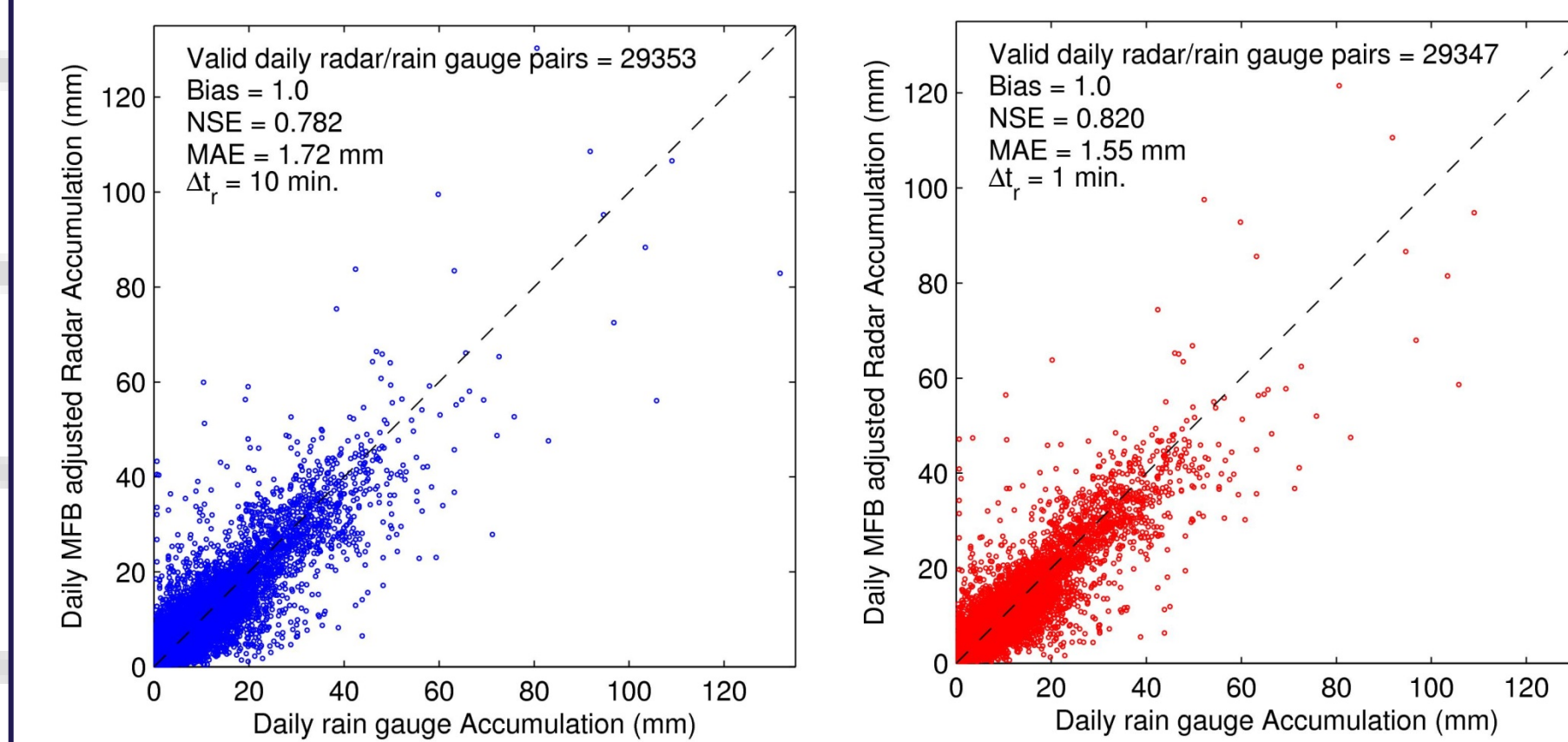
## 4. Performance measures

- Bias
- Nash-Sutcliffe-Efficiency (NSE)
- Mean Absolute Error (MAE)

## 5. Nomenclature

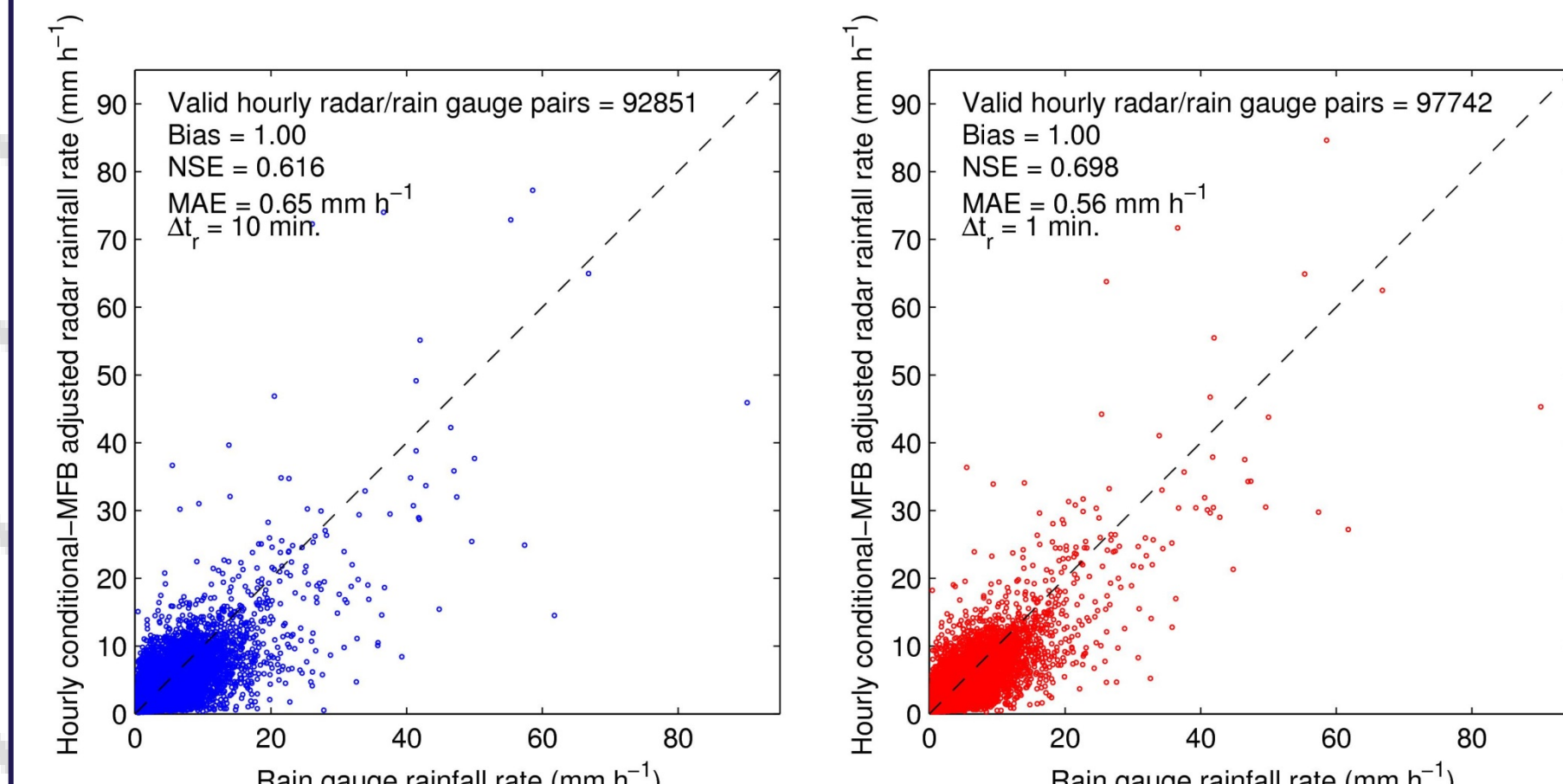
- Blue:** Original temporal resolution of data ( $\Delta t_r=10$  min.)
- Red:** Advection interpolated data ( $\Delta t_r=1$  min.)

## 6. Daily Mean Field Bias Adjustment



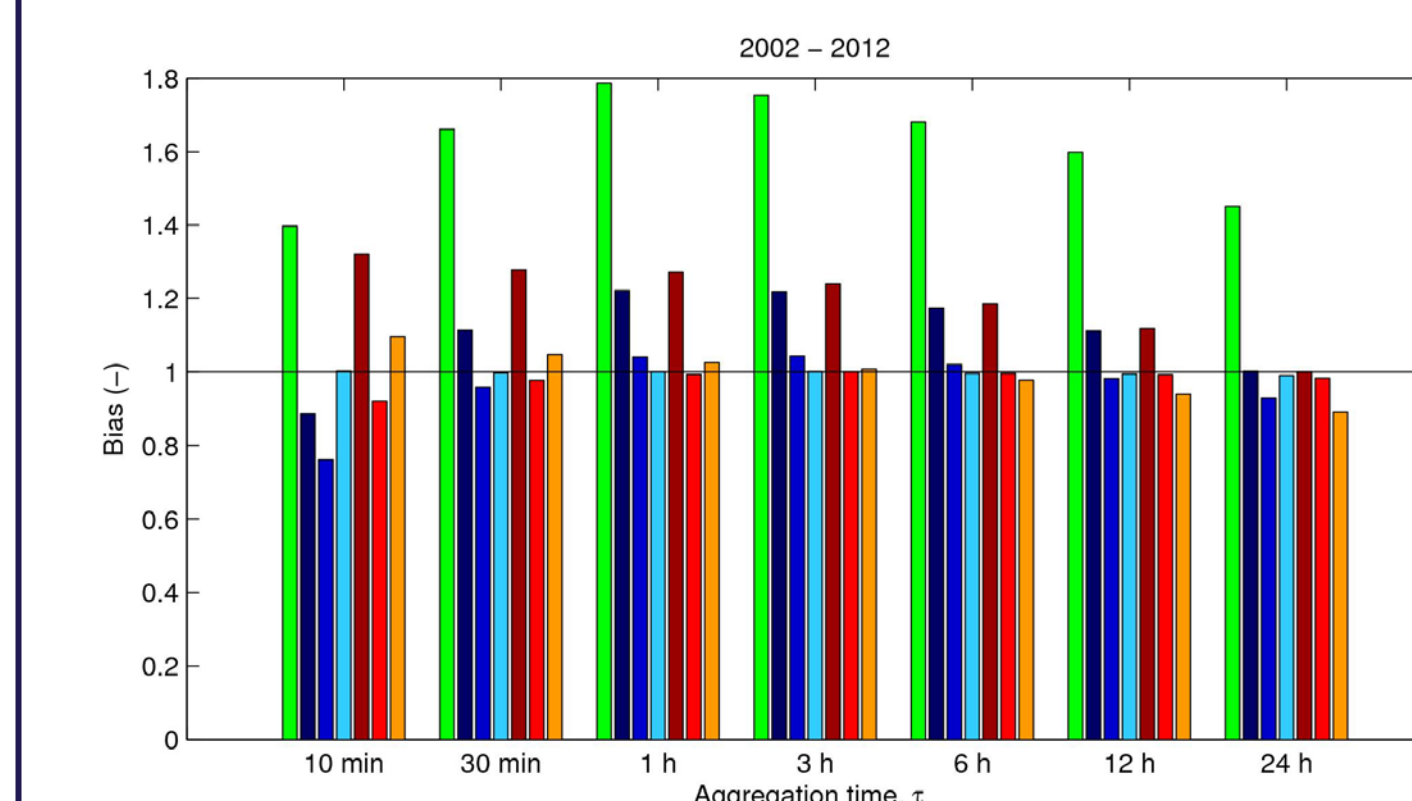
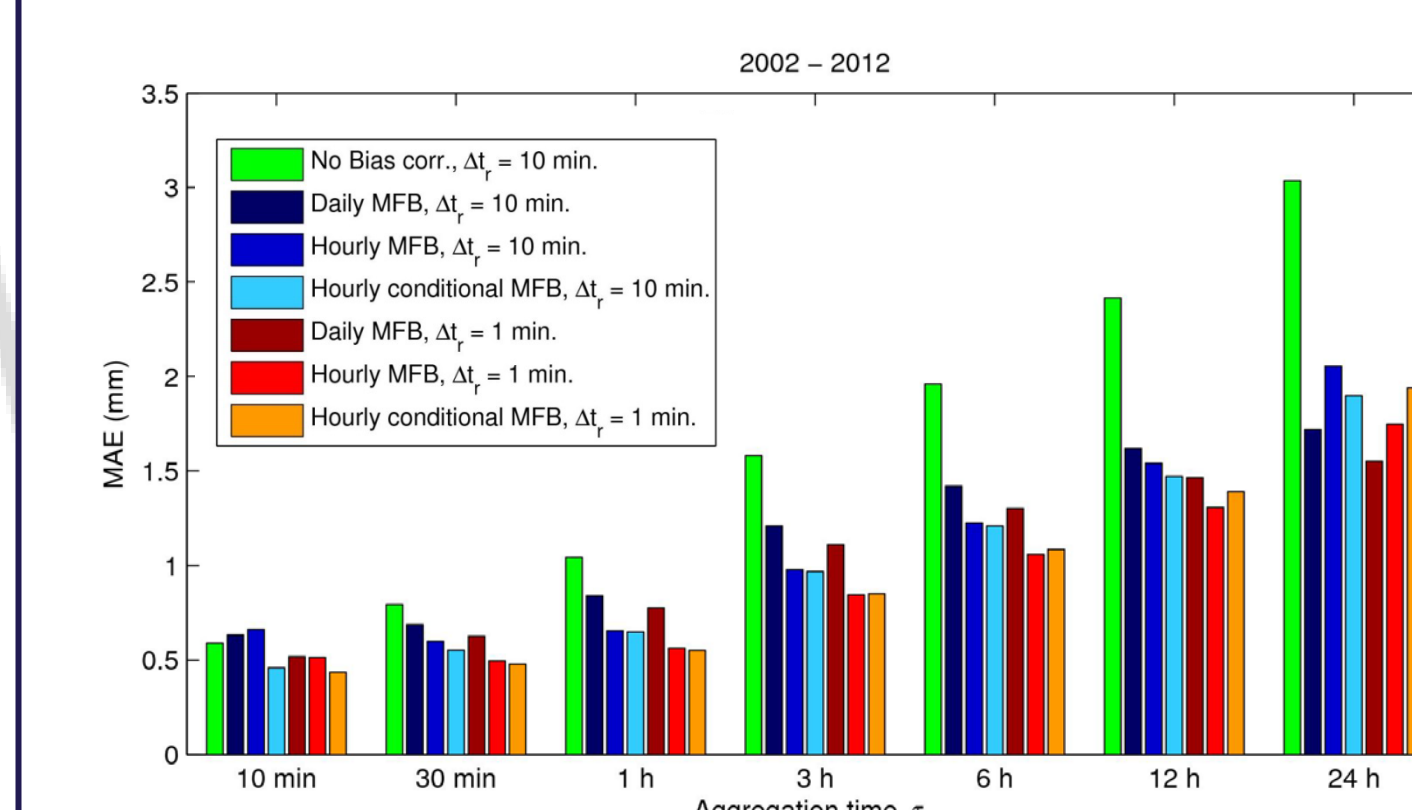
- Reduction of uncertainty (higher NSE and lower MAE) implementing advection interpolation
- Larger mean field biases during summer time (convective events)
- Larger bias variability during summer periods indicating large shifts in biases from day to day

## 7. Conditional Hourly Mean Field Bias Adjustment

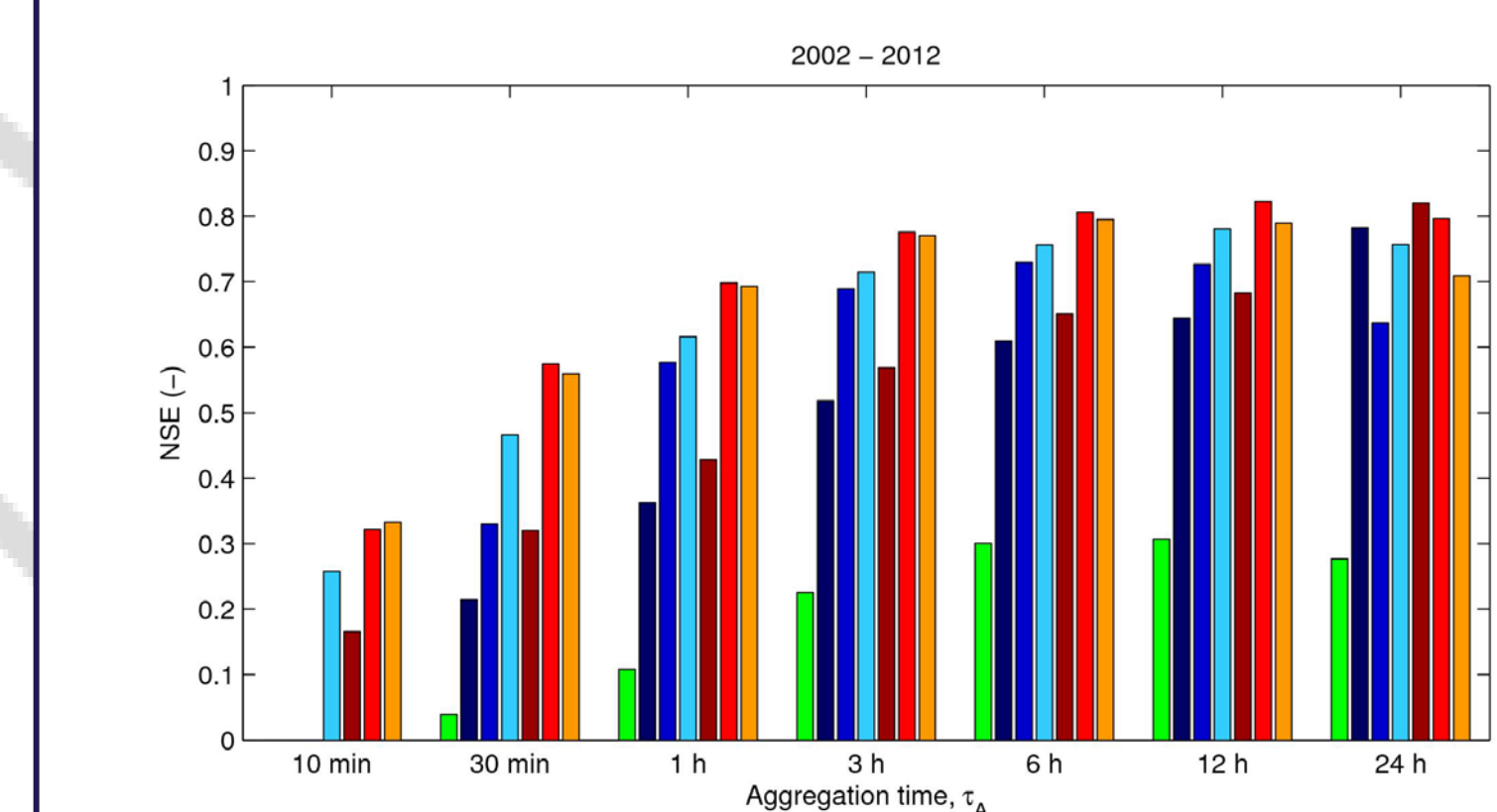


- Conditional bias adjustment improves hourly rainfall estimates compared to hourly mean field bias adjustment (not shown)
- Advection interpolated data provides better rainfall estimates
- Daily rainfall estimates is improved applying hourly bias adjustment (not shown)

## 8. Performance at different time scales



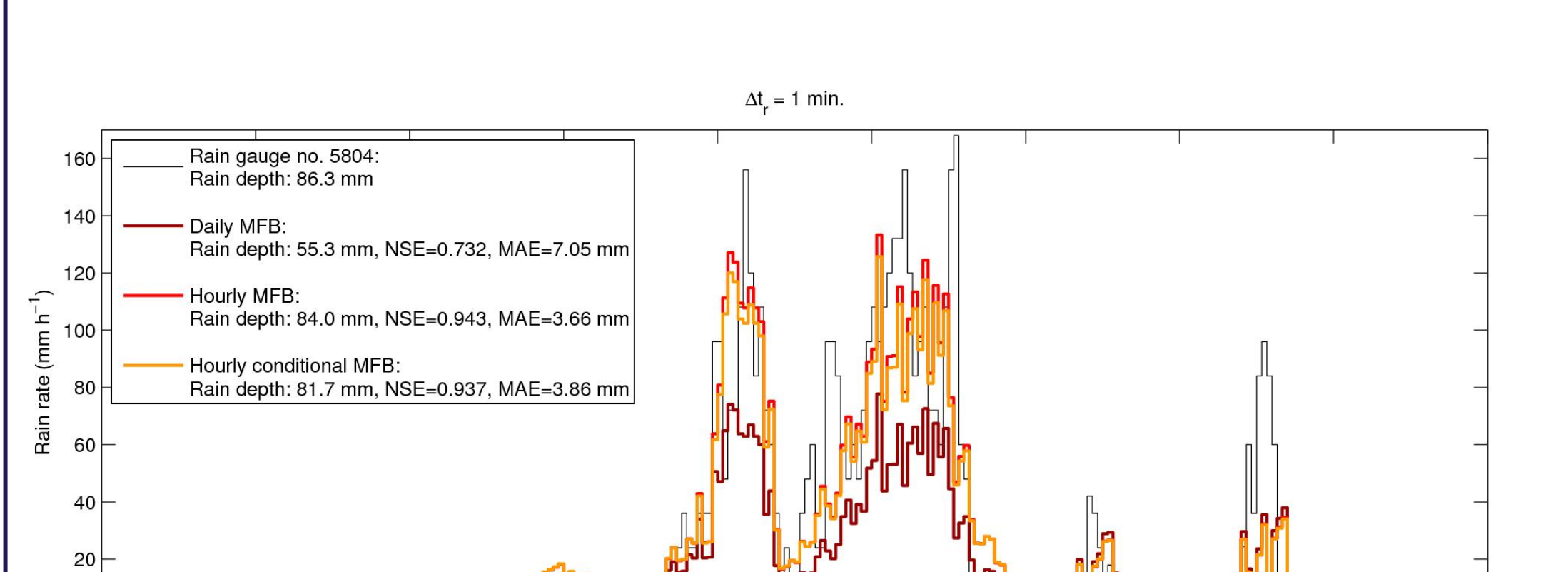
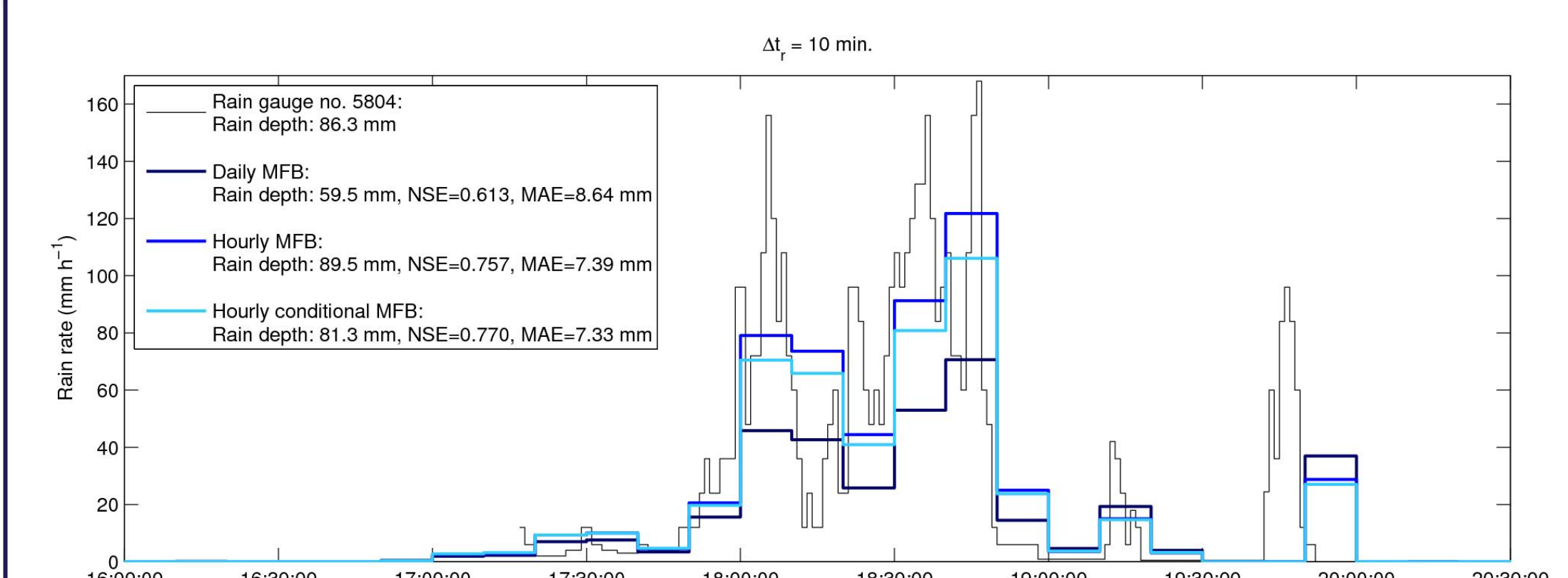
## 8. Performance at different time scales (cont.)



- Bias adjustment is crucial
- Hourly and conditional hourly mean field bias adjustment improves rainfall estimates at every time scale compared to daily adjustment (non-interpolated data)
- Applying advection interpolation improves both daily and hourly adjustments at every time scale
- No significant improvement of conditional bias adjustment on advection interpolated data
- Applying advection interpolation it is possible to generate reasonable 10 min. rainfall estimates which is not possible using non interpolated data.

## 9. Example of an extreme event: 2 July 2011

- This event produced record flooding in the greater Copenhagen area.
  - In some areas daily rainfall accumulation exceeded 140 mm (Daily accumulation estimated by hourly bias adjusted interpolated rainfall fields below)
- 
- Daily mean field bias is not sufficient in order to estimate rainfall totals nor peak rain rates.
  - Timing is improved significantly implementing advection interpolation.
  - Conditional bias adjustment is not crucial when advection interpolation is applied.



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